

Southern
Regional
Aquaculture
Center



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Channel Catfish

Life History and Biology

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Channel cattish, *Ictalurus punctatus* (Rafinesque), is the most important species of aquatic animal commercially cultured in the United States. It belongs to the family Ictaluridae, order Siluriformes. Members of the order Siluriformes are found in fresh and salt water worldwide. There are at least 39 species of catfish in North America, but only six have been cultured or have potential for commercial production. They are the **blue catfish**, *Ictalurus furcatus* (LeSueur); the **white catfish**, *Ictalurus catus* (Linnaeus); the **black bullhead**, *Ictalurus melas* (Rafinesque); the **brown bullhead**, *Ictalurus nebulosus* (LeSueur); the **yellow bullhead**, *Ictalurus natalis* (LeSueur); and the **flathead catfish**, *Pylodictis olivaris* (Rafinesque).

Distribution

Channel catfish were originally found only in the Gulf States and the Mississippi Valley north to the prairie provinces of Canada and Mexico, but were not found in the Atlantic coastal plain or west of the

Rocky Mountains. Since then channel catfish have been widely introduced throughout the United States and the world.

Physical characteristics

Like all native North American catfishes, a channel catfish has a body that is cylindrical in cross-section, and lacks scales. Fins are soft-rayed except for the dorsal and pectoral fins which have sharp, hard spines that can inflict a nasty, painful wound if a catfish is handled carelessly. An adipose fin (lacking rays)

is located on the back between the dorsal and caudal fins (Fig. 1). One conspicuous characteristic of all catfish is the presence of barbels around the mouth. The barbels are arranged in a definite pattern with four under the jaw and one on each tip of the maxilla (upper jaw).

The channel catfish is the only spotted North American catfish with a deeply forked tail. There are 24-29 rays in the anal fin. They are generally olivaceous to blue on the back, shading to the off-white ventrally.

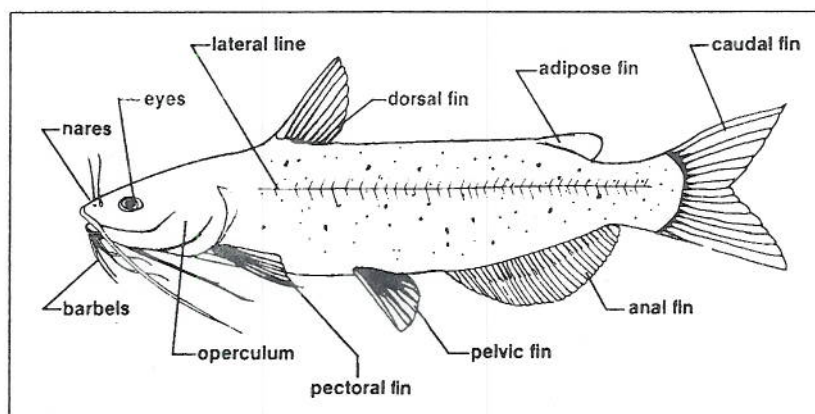


Fig. 1. External parts of the Channel Catfish.

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Their color, to a large extent, is dictated by the color of the water they inhabit. In clear water they may appear almost black, while in muddy water they may be a light yellow. Young channel catfish are irregularly spotted on their sides, but the spots tend to disappear in the adults.

Habitat

In natural waters channel catfish live in moderate to swiftly flowing streams, but they are also abundant in large reservoirs, lakes, ponds and some sluggish streams. They are usually found where bottoms are sand, gravel or rubble, in preference to mud bottoms. They are seldom found in dense aquatic weeds. Channel catfish are freshwater fish but they can thrive in brackish water.

Channel catfish generally prefer clear water streams, but are common and do well in muddy water. During the day they are usually found in deep holes wherever the protection of logs and rocks can be found. Most movement and feeding activity occurs at night just after sunset and just before sunrise. Young channel catfish frequently feed in shallow riffle areas while the adults seem to feed in deeper water immediately downstream from sand bars. Adults rarely move much from one area to another and are rather sedentary, while young fish tend to move about much more extensively, particularly at night when feeding.

Feeding

Feeding can occur during day or night, and they will eat a wide variety of both plant and animal material. Channel catfish usually feed near the bottom in natural waters but will take some food from the surface. Based on stomach analysis, young catfish feed primarily on aquatic insects. The adults have a much more varied diet which includes insects, snails, crawfish, green algae, aquatic plants, seeds and small fish. When available, they will feed avidly on terrestrial insects, and there are even records of birds being eaten. Fish become an important part of the diet

for channel catfish larger than 18 inches total length, and in natural waters fish may constitute as much as 75 percent of their diet.

Channel catfish primarily detect food with their sense of taste. Taste buds are found over the entire external surface of catfish as well as inside the mouth, pharynx and gill arches. They are most numerous on the barbels and gill arches. In clear water, eyesight can be an important means of finding food. However, in turbid water, taste is the primary way catfish locate food. The organ of smell (olfactory organs) may play some role, but this has not been well established. The olfactory organs are found in the nostrils (nares) which are located on top of the head just in front of the eyes.

Age and growth

Channel catfish grow best in warm water with optimum growth occurring at temperatures of about 85° F (29.4° C). With each 18° F (10° C) change in temperature there is a doubling or halving of their metabolic rate. This means that within limits, their appetite increases with increasing water temperatures or decreases with decreasing water temperatures.

In natural waters, the average size channel catfish caught by fishermen is probably less than 2 to 3 pounds, but the world record of 58 pounds was caught in Santee Cooper Reservoir, South Carolina, in 1964. The size and age that channel catfish reach in natural waters depends on many factors. Age and growth studies have shown that in many natural waters channel catfish do not reach 1 pound in size until they are 2 to 4 years old. One study in the Lake of the Ozarks, Missouri, found that channel catfish did not reach a size of 13 inches total length until they were 8 years old. The maximum age ever recorded for channel catfish is 40 years, whereas most commercially raised catfish are harvested before they are 2 years old.

In production ponds the mouth rate of channel catfish is determined by water temperature; length of time held at different water temperatures; quantity and quality of food fed; palatability, or taste of food; frequency of feeding; water quality, etc. Most farm-raised catfish are harvested at a weight of 11/4 pounds at an age of about 18 months.

Water quality

Water quality preferences and limitations for wild channel catfish are not any different from those of farm-raised channel catfish. The lethal oxygen level for both wild and farm-raised catfish is about 1.0 ppm, and reduced growth occurs at oxygen concentrations of less than 4 ppm. Channel catfish, in natural waters, are no more tolerant of high levels of ammonia and nitrites than are farm-raised catfish, but are seldom exposed to lethal concentrations of either ammonia or nitrite.

Respiration

Like other animals, channel catfish need oxygen to live. They use oxygen for energy production and to help build all the various parts of the body. However, oxygen is at most only about 25 percent as abundant in water as in the air. To get oxygen, fish must expend more energy than air-breathers. Fortunately, fish have well developed breathing organs, the gills. Although catfish live in the water, gills serve essentially the same functions as our lungs--to take oxygen from the external environment and to rid the body of toxic gaseous waste, carbon dioxide (CO₂). Water passes over the gill surface where oxygen diffuses into the blood and carbon dioxide diffuses out.

The gills of channel catfish are located on each side of the head (Fig. 2) and they are covered by a protective movable flap of skin called the gill flap or operculum. There are four gills on both sides of the head, each consisting of a double row of slender gill filaments.

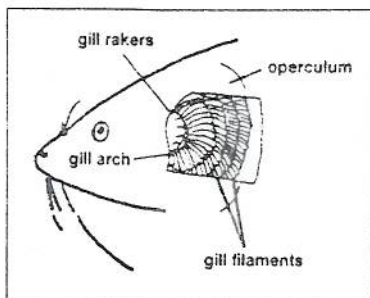


Fig. 2. Schematic drawing of fish gills.

These filaments are supported by a flexible white gill arch. Each side of the filament has many thin, small cross plates called lamellae. It is across the gill lamellae that the important respiratory gases are exchanged (Fig. 3).

A fish breathes by sucking water in through the mouth where it flows directly over the gill filaments and across the lamellae. Blood channeled through the heart has a low oxygen concentration, but at the gill lamellae surface it passes near water high in oxygen. By simple diffusion, oxygen crosses the gill surface and enters the blood where it is carried throughout the fish. Respiration of this type is called counter-current exchange. Simple diffusion of oxygen through the gill lamellae and into the blood occurs because the gill lamellae are extremely thin.

Carbon dioxide is released from fish in much the same way oxygen is taken in--by counter-current exchange. Blood high in carbon

Similarly, if the oxygen concentration in the water is low, a fish has to breathe faster if it is to meet all of its oxygen requirements. During normal respiration only about 60 percent of the gill surface is used for gas exchange. During increased respiratory demands, up to 100 percent of the gill surface may be used.

It is easy to see that any alteration in gill structure or function can be dangerous to catfish. Any increase in the thickness of the gill lamellae will decrease the efficiency of gas diffusion. If the gills become swollen or puffy oxygen and carbon dioxide transfer are decreased. Gills can become thickened following exposure to ammonia, certain vitamin deficiencies or to long-term parasite or bacterial infestations. Any type of toxic agent which damages the gill filaments or lamellae will also affect the efficiency of gas exchange. Finally, if a fish is anemic or has brown blood disease, even though the gills are not damaged and there is adequate oxygen in the water, the blood may not be able to carry enough oxygen to ensure survival.

Spawning

Channel catfish spawn when the water temperature is between 75° and 85° F (23° to 30° C) with about 80° F (27° C) being optimum. Wild populations of catfish may spawn as early as late February or as late as August depending on the location. The length and dates of the spawning season vary from year to year depending on the weather and area, but peak spawning time in Mississippi usually occurs in May.

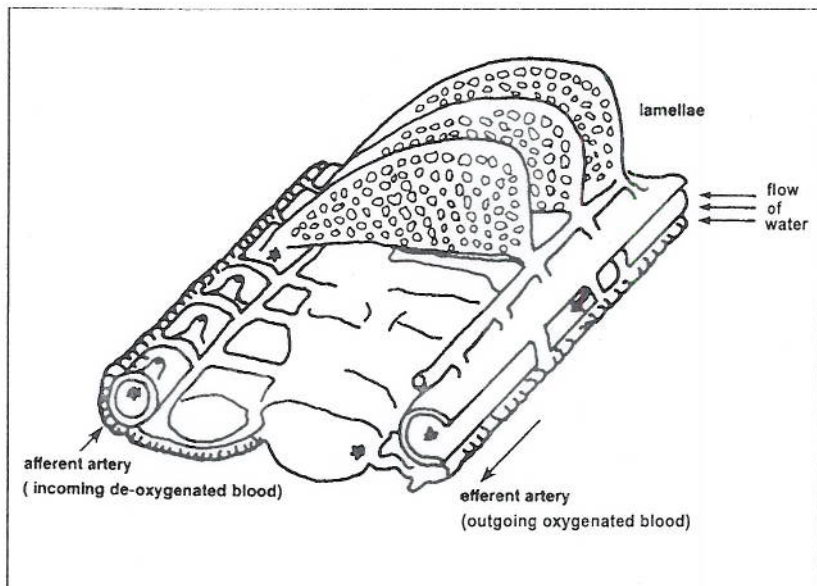


Fig. 3. Schematic drawing of gill filament.

Each gill and gill filament has a rich supply of blood vessels which carries blood from the heart to the gills and then throughout the fish. The lamellae have spaces through which blood rapidly percolates. Oxygen that is picked up at the gill lamellar surface is carried throughout the body in the blood. Waste carbon dioxide is also carried in the blood for release into the water at the lamellar surface.

dioxide is channeled through the heart to the gills where it comes in close contact with water low in carbon dioxide. By simple diffusion carbon dioxide is then released into the water.

Depending on the needs of the fish, the rate of breathing maybe variable. Fish that are stressed or are pursued by a predator have a greater oxygen demand than fish at rest.

Channel catfish are cavity spawners and will spawn only in secluded, semi-dark areas. In natural waters male catfish will build a nest in holes in the banks, undercut banks, hollow logs, log jams or rocks. It is this behavior that necessitates the use of spawning containers in order to successfully spawn channel catfish in commercial ponds.

The male selects and prepares the nest by fanning out as much mud and debris as possible. He will then defend this location against any intruder until spawning is completed and the fry leave the nest. The female is attracted to the nest and spawning occurs within the nest with eggs being laid in a gelatinous mass on the bottom. After the eggs are laid, the male takes over and cares for the eggs by constantly fanning them with his fins to provide aeration and to remove waste products given off by the developing eggs.

Females spawn only once a year, producing about 3,000 to 4,000 eggs per pound of body weight, while the males may spawn more than once. In wild populations, males seldom

spawn more than once a year, but in hatcheries where the eggs are removed from the spawning container soon after being laid, males may spawn 3 or 4 times; and there is a record of one male spawning nine females in one season. Channel catfish usually become sexually mature at 3 years of age, although some may spawn when 2 years old. In wild populations they may not spawn until after the age of 5 years. Channel catfish weighing as little as 3/4 of a pound may spawn if old enough, whereas farm-raised catfish usually weigh in excess of 2 pounds when they spawn. After the eggs are laid they will usually hatch in 5 to 10 days depending on water temperature. At 78° F (26° C) the eggs will hatch in about 8 days. For each 2° F (1° C)

rise in temperature above 78° F, subtract 1 day, and for each 2° F (1° C) fall in temperature below 78° F, add 1 day to get the approximate length of time required for hatching. Water temperatures below 65° F (18° C) and above 85° F (30° C) will reduce hatching success. Newly hatched fry have a large yolk sac which contains the nourishment they need for the next 2 to 5 days until they are fully developed and are ready to start feeding. After the yolk sac is absorbed, the fry take on their typical dark color and will begin to swim-up looking for food. At first swim-up fry will gulp air to fill their swim bladders which helps them maintain and regulate their buoyancy.

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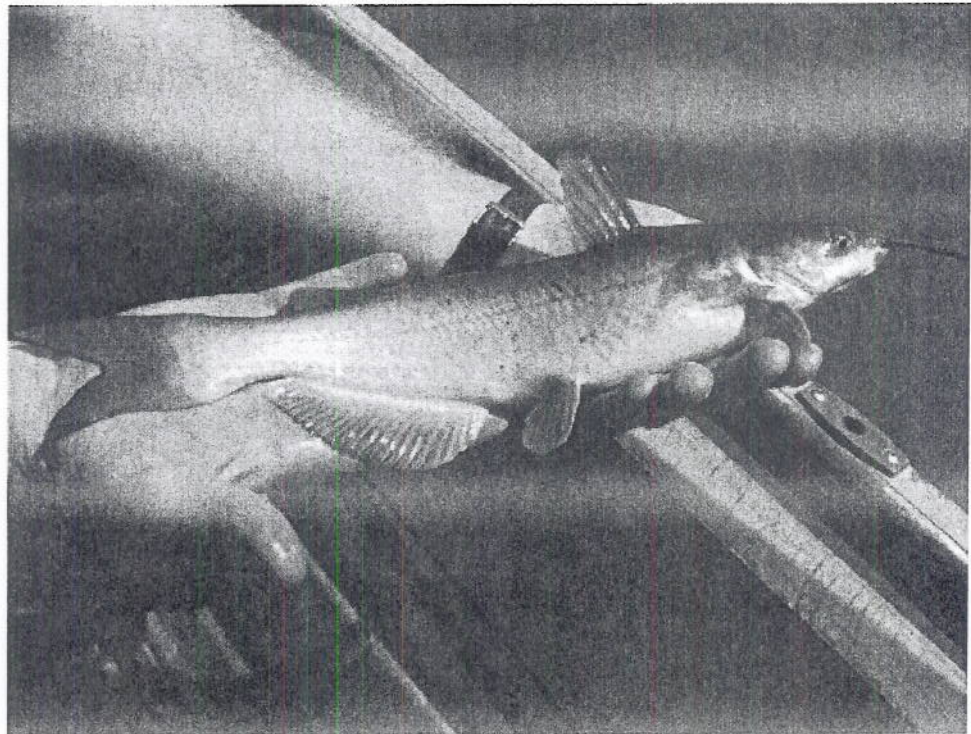
Exhibit B

University of California
California Fish Website

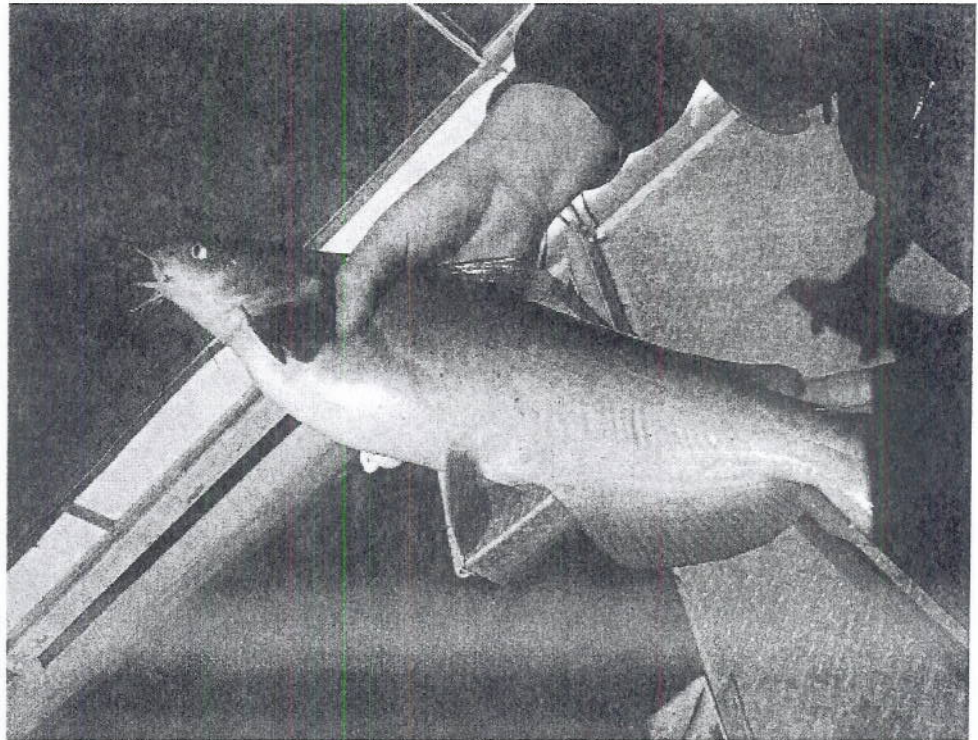
California Fish Species

Fish	Channel Catfish
Scientific Name	Ictalurus punctatus
Native	Non-Native

Identification



Channel catfish, caught in Nacimiento Reservoir in May 2008 by Teejay O'Rear. Photo by Amber Manfree.



Channel catfish, captured in rotary screw trap on Sacramento River at Knight's Landing. Photo by Dan Worth, California Department of Fish and Game.



Channel catfish. Location: Balboa Park reflecting pond, San Diego, CA, 2009. The fish, estimated to be 10-12 years old, was popular with visitors. It died 24 May 2009, apparently of natural causes. Weight: 10.3 kg (22.7 lb). Photo by Neal Matthews.

- Elongate body with a small head
- Deeply forked tail with pointed lobes
- Terminal mouth with 1 black barbel on either side and 4 dusky to white chin barbels
- Maxillary barbels are longer than the head
- Upper jaw protrudes past lower jaw
- Gray-blue on the sides, often with a olive green tinge, fading to white on the belly covered in scattered black spots
- Young have black tipped fins
- Spawning males become dark with enlarged heads, thickened lips, fatty pads behind the eyes, and thickened fin membranes

- Males also have a urogenital papilla extending towards the tail leaving one opening behind the vent compared to the 2 openings on females
- 5-6 soft rays in the dorsal fin
- 24-29 rays in anal fin
- 4-5 soft rays in pectoral fins

Life History

Channel catfish are found mostly in the main channels of large, warm water streams with sand, gravel, or rubble bottoms but can also be found in farm ponds, reservoirs, and turbid, muddy bottomed rivers. They are capable of surviving in waters with salinities as high as 10 ppt, temperatures as high as 36-38°C, and dissolved oxygen levels as low as 1-2 mg/L. Adults stay in pools or beneath logjams and undercut banks during the day and move into the faster moving parts of the stream at night to feed. Juveniles are not strong enough swimmers for these currents and instead stay in riffles where the flow is slowed by the rocky bottom. Channel catfish are technically an omnivorous species but they tend to be more predatory in practice. Juveniles feed on crustaceans and insect larvae and will begin hunting fish and crayfish as they grow older. An individual larger than 30-38 cm will focus its diet towards fish but will eat anything from insects to small mammals if it can fit it in its mouth.

Growth is variable depending on location but in good habitat channel catfish will reach a length 7-10 cm in their first year and 35-45 cm in their fifth. Some fish have been found to live longer than 40 years, weigh over 26 kg, and grow to be longer than 1 m but California fish older than 10 years or longer than 53 cm are rare. Reproductive timing is also fairly variable with first spawning points ranging from 2 to 8 years old and lengths between 18 and 56 cm, but the typical maturation point is 3 years old and at least 30 cm in length. Depending on the region, spawning occurs between April and August when temperatures are between 21°C and 29°C. Channel catfish need sheltered, cave-like sites for nests and often use old muskrat burrows, undercut banks, logjams, riprap of large rocks, and even dumped barrels. These may sometimes be difficult to find and while some females may spawn twice in a season it is not uncommon for planted populations to fail to spawn entirely. If an appropriate area is found, males will clear away and protect the nest site before the pair mates. They will mate multiple times until the female lays all her eggs: between 2,000 and 70,000 depending on her size. The males will stay with the nest, fanning it to maximize the oxygen available to the eggs until they hatch 5-10 days later. The 10-12 mm long juveniles start swimming after a couple days but will not leave the protection of the nest and the males until 7 days after hatching. When the juveniles do leave the nest they may school together as a group for some time before departing on their own when they reach approximately 25 mm in length.

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